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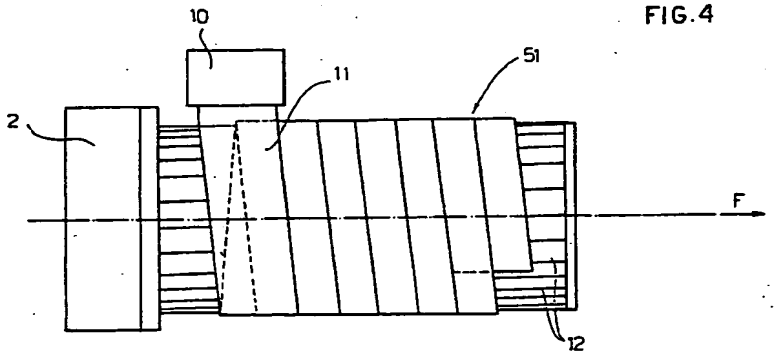
(54) Process and equipment for manufacturing pipes from recycled thermoplastic resins

(57) A process and equipment for manufacturing thermoplastic resin pipes (50), particularly for sewage networks and land drainage, made from high and low density polyethylene, polypropylene, polyvinyl chloride, polystyrene (including foam polystyrene), and heterogeneous mixtures of recycled materials.
The process consists in extruding a flat sheet of thermoplastic material, winding said sheet in a spiral on the rotating rollers (12) of a shaping mandrel (2) to obtain a cylindrical basic pipe (51), and in applying on said basic pipe (51) a spiral reinforcing strip (52), consisting of an outer layer of the same thermoplastic material as the basic pipe (51) and an inner filling layer obtained with the mixture of heterogeneous recycled material.

FIG.4



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Description

The present invention relates to a process and equipment for manufacturing thermoplastic resin pipes, intended for use particularly for sewage networks and land drainage.

The thermoplastic resins used can consist of high and low density polyethylene, polypropylene, polyvinyl chloride, polystyrene (including foam polystyrene), and heterogeneous mixtures of recycled materials.

These thermoplastic resin pipes are currently manufactured by winding a continuous extruded strip in a spiral on a mandrel.

Italian patent application No. MI 95 A 000925 dated 9 May. 1995, not yet published, describes a manufacturing method for coextruded pipes that makes use of a continuous extrusion with at least one longitudinal inner cavity, possibly filled with recycled materials, and covered on the outside with higher quality plastic.

This method, though being more advantageous than the others, in that it can use low quality materials for the inner extrusion, presents the drawback that it must be of considerable thickness, in order to achieve acceptable welding between the sides of the extruded strips.

The aim of the invention is precisely to eliminate this drawback, allowing a pipe wall of limited thickness to be obtained without detracting from its strength.

A further aim of the invention is to make said pipe at a low cost.

This aim is reached, in accordance with the invention, with the characteristics listed in the attached independent claims.

Preferred embodiments of the invention emerge from the dependent claims.

Basically, according to the invention, the pipe is made by winding a flattened strip in a spiral, with partial overlapping, so as to obtain an excellent seal with small strip thickness.

While the pipe thus obtained is being formed, a reinforcing strip made from recycled materials is applied to the outside and wound in a spiral on the basic pipe.

Further characteristics of the invention will be made clearer by the detailed description that follows, referring to a purely exemplary, and therefore non-limiting, embodiment illustrated in the attached drawings, in which:

- Figure 1 is a schematic view from the outside of a pipe obtained with the procedure according to the invention;
- Figure 2 is a longitudinal section of a wall of the pipe, on which are shown, by way of example, different designs for the reinforcing strip;
- Figure 3 is a schematic plan view of the essential elements of an equipment for manufacturing the pipe according to the invention;
- Figure 4 shows a pipe being formed on the shaping mandrel;
- Figure 5 schematically illustrates forming of the reinforcing strip.

Figure 1 shows a pipe, indicated as a whole with reference number 50, obtained with the process and with the equipment according to the invention.

A pipe 50 comprises a body or basic pipe 51 with a smooth cylindrical wall, and an outer reinforcement 52, consisting of a spiral wound around the basic pipe 51.

The basic pipe 51 is made of thermoplastic material, whilst the reinforcing strip 52, which can have various shapes, as illustrated in Figure 2, comprises a heterogeneous recycled material 53, acting as a filler, and an outer covering layer 54, of thermoplastic material, which is welded to the outer wall of the basic pipe 51.

In this way, the thickness of the basic pipe 51 can be smaller than that of conventional pipes of the same diameter, its strength being ensured by the outer reinforcing strip 52.

Figure 3 schematically illustrates equipment for manufacturing the pipe 50 according to the invention.

This equipment comprises an extruder 1 (double- or single-screw) with a flat-head die 10 from which a sheet or strip 11 emerges (Figure 4), for formation of the basic pipe 51, winding it in a spiral on a shaping mandrel 2, as will be better explained below.

The shaping mandrel 2 consists of a variable speed drive which, by means of gearing (not illustrated), sets in motion a series of rollers 12, on which the strip extruded as a sheet 11 by the flat head 10 is wound in a spiral. The rotating rollers 12 can be inclined with respect to the central axis of the shaping mandrel 2, and this inclination determines the pitch of the single turns of the wound strip, which advance on the mandrel in the direction of the arrow F in Figure 4, partly overlapping on each other and giving rise, after they have been welded, to the continuous basic pipe 51.

The equipment also comprises a second extruder (double- or single-screw) 3, provided with a degassing device, for plastification of the heterogeneous recycled materials forming the inner part 53 of the reinforcing strip 52.

Alongside the extruder 3, a third extruder 4 (double-screw or single-screw) is provided, for plastification of the outer layer 54 of the reinforcing strip 52.

The two extruders 3 and 4 converge in a coextruding head 5, from which the reinforcing strip 52 emerges.

In figure 3 reference number 8 indicates pressure rollers that press the strip 11 extruded by the flat head 10 against the rollers 12 of the shaping mandrel, whilst 9 indicates the pressure rollers for the reinforcing strip 52. The pressure rollers 9 are offset axially to allow the spiral to be formed on the basic pipe 51. Downstream of the shaping mandrel 2 a cutting station is situated, schematised in Figure 3 and indicated by reference number 6, consisting of a circular saw synchronised

with feeding of the pipe 50, which allows a cut to be made perfectly at right angles to the axis of the pipe.

In Figure 3, lastly, the number 7 indicates a block showing the control panel for all the operations necessary for running of the equipment.

The equipment according to the invention is operated, thus carrying out the relative procedure, already described in part above, as follows:

When the extruder 1 is started, the sheet 11 of thermoplastic material leaving the flat head 10 is deposited on the rotating rollers 12 of the shaping mandrel 2 and, overlapping on the preceding turn with each revolution of the mandrel, determines the shape and thickness of the basic pipe 51. The rotating rollers, depending on the pre-set inclination with respect to the axis of the mandrel, give rise to the feed pitch of the extruded sheet 11 and, at the same time, the layers that are to be placed one on top of the other to obtain different pipe section thickness. The pressure rollers 8 ensure perfect welding of the single layers.

The reinforcing strip 52, on leaving the coextrusion head 5, falls on the outer surface of the basic pipe 51 and is drawn by the latter through the rotation transmitted by the shaping mandrel 2. Immediately after the point of contact, the reinforcing strip 52 encounters a shaped pressure roller 9 that determines its shape, also helping it to adhere to the outer surface of the basic pipe 51. Suitable preheating systems are used to ensure optimal welding, The other shaped rollers 9, orientated according to the pitch, contribute to shaping, welding and cooling of the reinforcing strip.

All the rollers and pressure rollers of the shaping mandrel 2 are connected to a thermostated fluid circuit in order to control cooling of the thermoplastic materials adequately and thus establish production efficiency levels.

The use of heterogeneous plastic products to form the filling layer 53 of the reinforcing strip 52 gives rise during plastification in the extruder 3, to the formation of decomposition gases given off by non-thermostable products and evaporation of the moisture contained in them. To obtain a uniform plastic mass in the reinforcing strip, such as to enhance its structural characteristics, it is preferable to work with an extruder equipped with vacuum degassing.

The residual gases generated at the outlet from the coextrusion head 5 are further reduced by using a special apparatus 20 equipped with a needle element 21 to make holes at close intervals on the surface of the reinforcing strip that will then be welded to the basic pipe 51, thus closing the holes, as shown schematically in figure 5.

Downstream of the perforating apparatus 20, suitably orientated squeeze rollers 21 are provided, their purpose being to expel the gases through the holes made with the needle 21.

The procedure described for manufacturing of buried pipes makes it possible, by acting on the production parameters, to obtain products with different characteristics that comply with the technical standards imposed by the current international regulations for the sector.

This procedure makes it possible to manufacture a product 50 for use in sewage pipes and drainage using as the structural reinforcing element heterogeneous thermoplastic materials coming from separate collection of solid municipal refuse.

A basic element of this solution is the possibility of obtaining high mechanical strengths from heterogeneous materials by exploiting them as stiffening fillers.

The thermoplastic material used for the basic pipe 51 and for the outer layer 54 of the reinforcing strip 52 can equally be obtained from recycling of homogeneous good-quality thermoplastic materials, ensuring that the finished product has a very low cost.

Last but not least, it must be considered that heterogeneous plastic residues are difficult to dispose of and that the presence of polyvinyl chloride precludes their incineration in many of the existing plants.

The use foreseen for said materials in the described process is therefore the most suitable from all points of view.

Claims

1. A process for manufacturing thermoplastic resin pipes, comprising the following steps:

   a) extrusion of a continuous strip (11) as a flat sheet of thermoplastic resin
   b) winding of the strip (11) in a spiral on a shaping mandrel (2), with partial overlapping of the individual turns, to obtain a basic pipe (51):
   c) application on said basic pipe (51) of an outer reinforcing strip (52) wound in a spiral and welded to the basic pipe.

2. A process according to claim 1, characterised in that said outer reinforcing strip (52) comprises an inner filling layer (53) and an outer layer of the same thermoplastic material as the basic pipe (51).

3. A process according to claim 2, characterised in that said filling material (53) is a heterogeneous recycled material.

4. A process according to any one of the preceding claims, characterised in that it provides for degassing during plastification of said filling material (53) for the reinforcing strip (52).

5. Equipment for manufacturing thermoplastic resin pipes (50) comprising the following elements:

   a) an extruder (1) for thermoplastic materials equipped with a flat head die (10) for extrusion of a continuous strip in sheet form (11);

b) a shaping mandrel (2) equipped with a series of rotating rollers (12) on which said continuous strip (11) is wrapped in a spiral with partial overlapping of adjacent turns,

c) a coextrusion head (5) for a reinforcing strip (52) wrapped in a spiral on the basic pipe (51).

6. Equipment according to claim 5, characterised in that two extruders (3, 4), for a filling material (53) and an outer layer (54), respectively, converge upon said coextrusion head (5), together giving rise to the reinforcing strip (52).

7. Equipment according to claim 6, characterised in that a degassing station is provided downstream of said coextrusion head (5) comprising a perforating apparatus (20, 21) and squeeze rollers (22).

8. Equipment according to any one of the preceding claims from 5 to 7, characterised in that it provides for shaped pressure rollers (9) to be coupled with the rollers (12) of the shaping mandrel (2), to give the desired shape to said reinforcing strip (52).

9. A thermoplastic resin pipe for sewage networks or land drainage, comprising a cylindrical basic pipe (51) on the outer surface of which is applied a reinforcing strip (52) consisting of an outer layer of the same thermoplastic material as the basic pipe and an inner filling layer of heterogeneous recycled material.

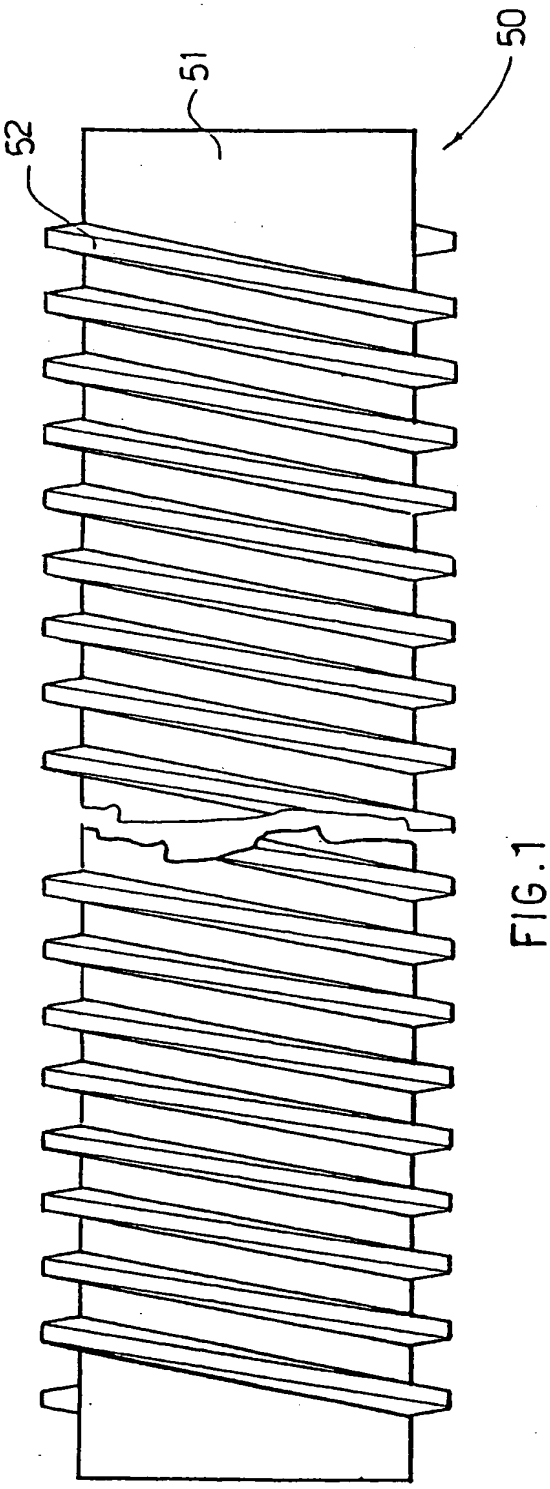


FIG.1

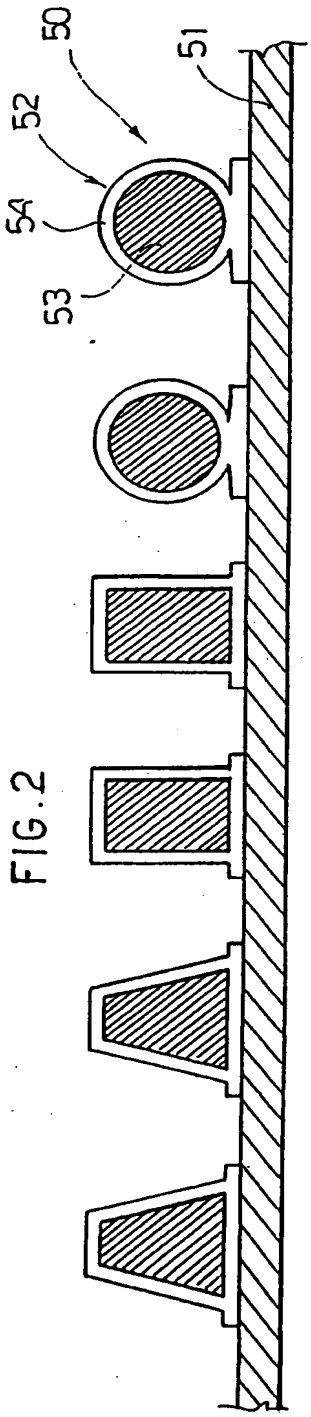


FIG.2

FIG.3

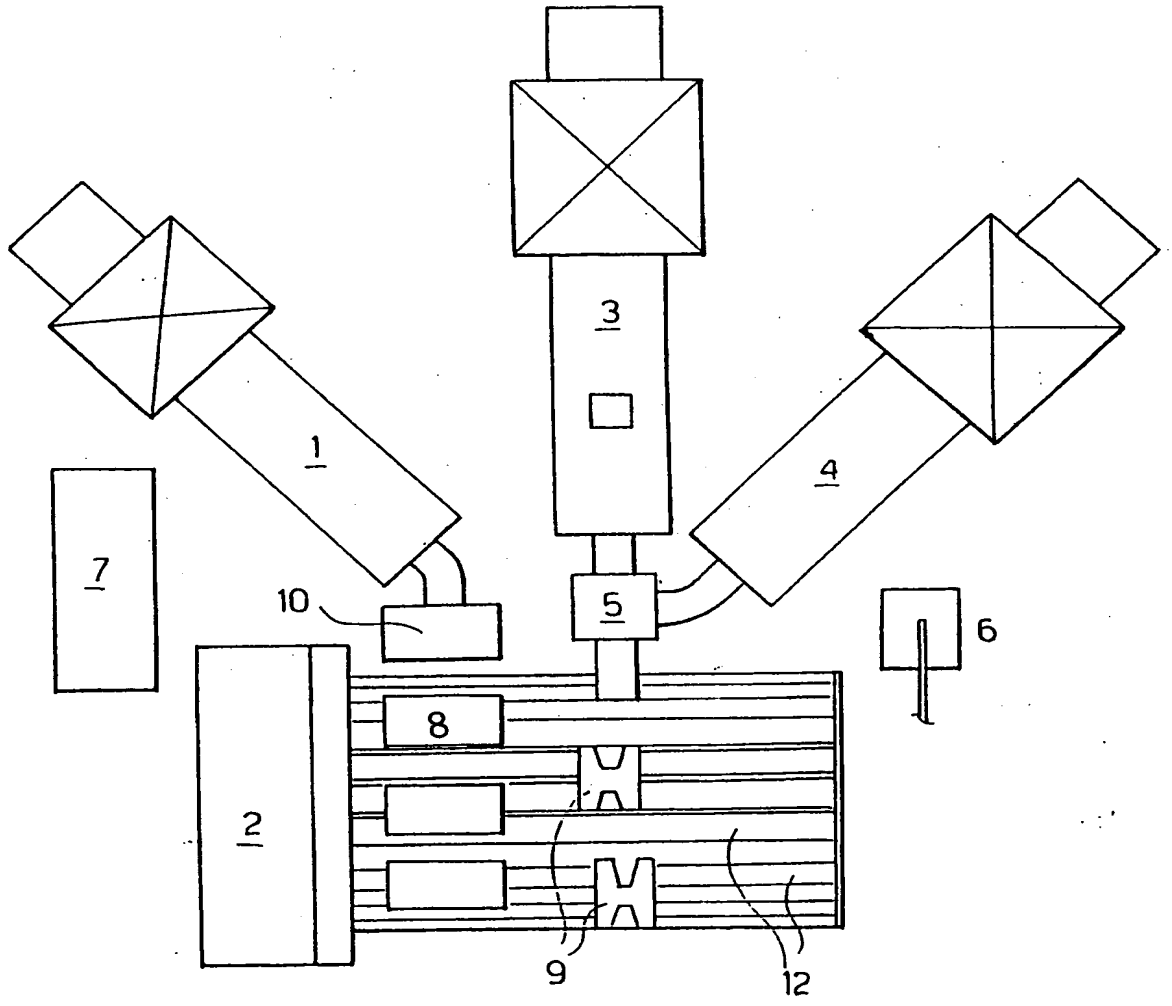


FIG.4

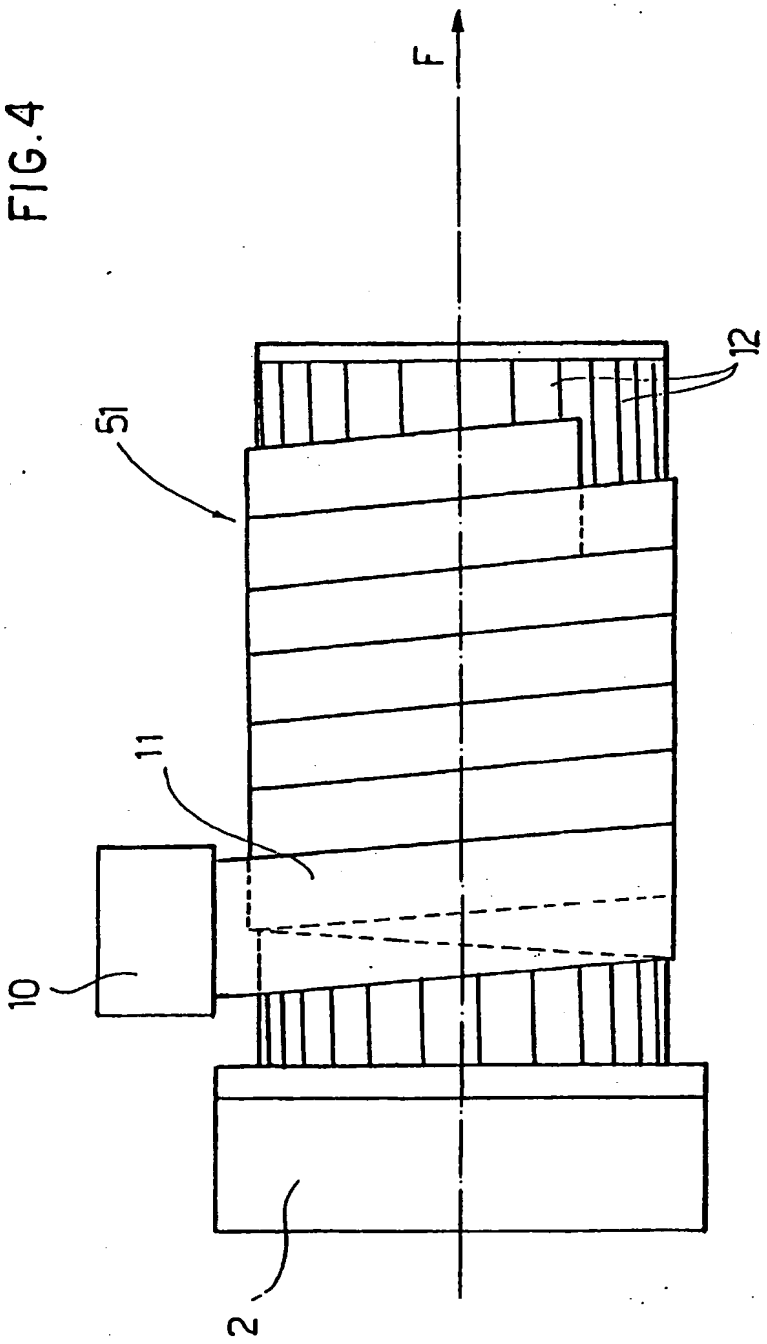
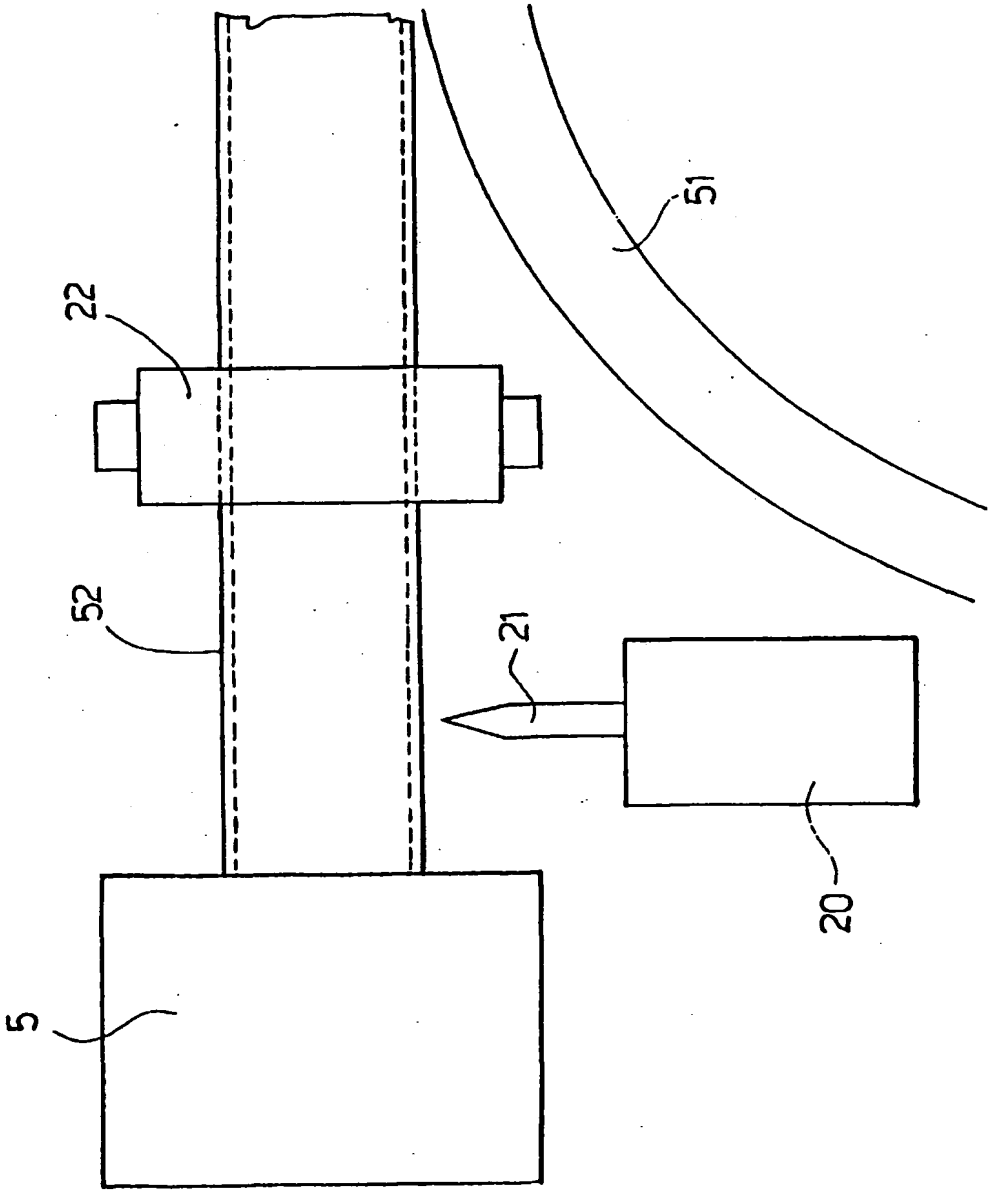


FIG.5



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EUROPEAN SEARCH REPORT

Application Number
EP 97 10 9908

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 826 423 A (KEMP ERIC E ET AL) 2 May 1989 * column 3, line 14 - column 5, line 40 * * figure 1 *	1,2	B29C53/62 B29C47/76 //B29K105:26
A	---	9	
X	EP 0 535 326 A (STROPPIANA FERNANDO) 7 April 1993 * column 1, line 1 - line 6 * * column 2, line 43 - line 58 * * column 4, line 53 - column 5, line 37 * * figures *	1,5	

X	US 3 938 929 A (STENT VERNON DENNIS ET AL) 17 February 1976 * column 1, line 1 - line 52 * * column 4, line 50 - column 5, line 29 * * figures *	1,2,5,8	

A	FR 2 218 987 A (STEIGER ENGINEERING AG) 20 September 1974 * page 3, line 6 - line 12 * * page 6, line 37 - page 7, line 9 * * page 10, line 38 - page 11, line 5 * * figure 11 *	1,9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B29C

A	EP 0 584 501 A (JAPAN STEEL WORKS LTD) 2 March 1994 * claims 1,5 *	4	

A	US 3 477 891 A (HAWERKAMP MANFRED) 11 November 1969 * figure 1 *	8	

A	DE 44 09 944 A (SACHSE LOTHAR) 28 September 1995 * claims 1-3 *	4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 September 1997	Lanaspeze, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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